J. N. FLOOD.

METHOD AND APPARATUS FOR SAVING SLIMES IN ORE CONCENTRATION.

APPLICATION FILED NOV. 23, 1908.

919,709.

Patented Apr. 27, 1909.

3 SHEETS—SHEET 1.

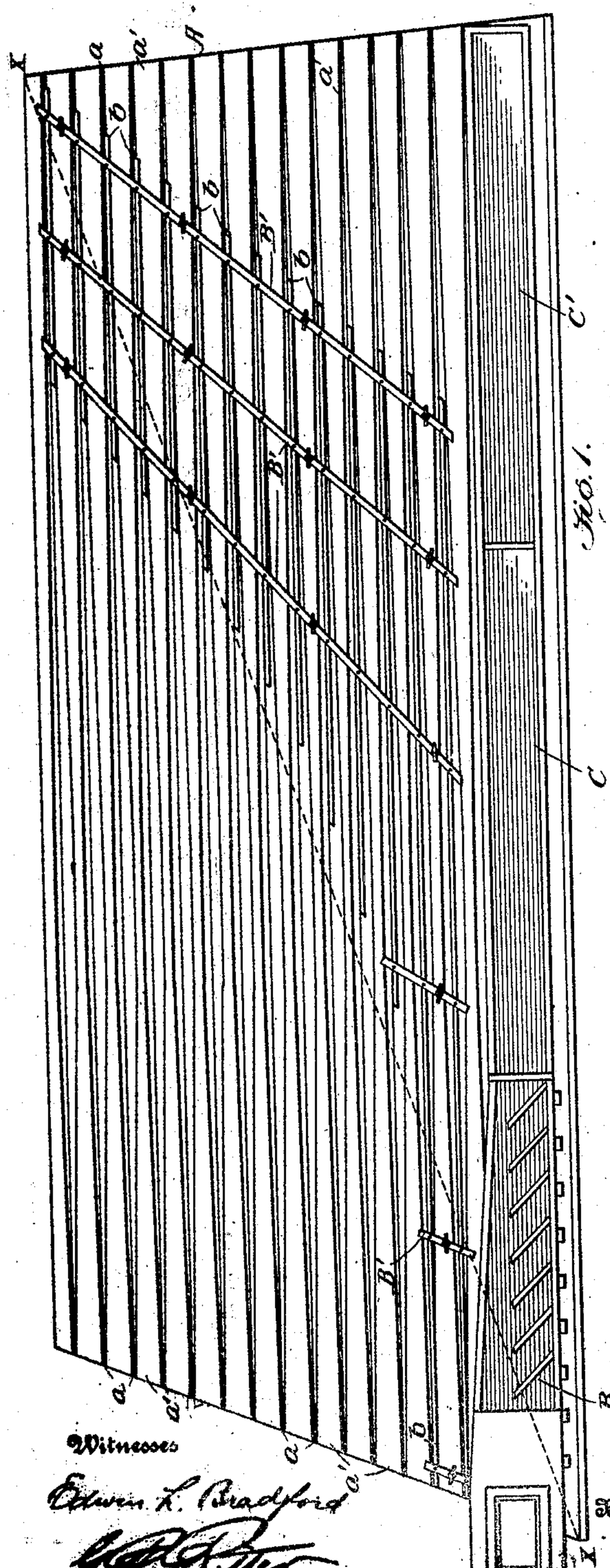

Fig. 1.

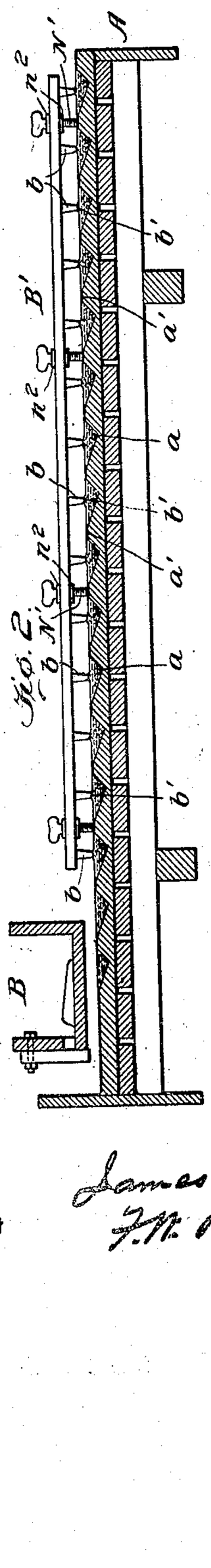

Fig. 2.

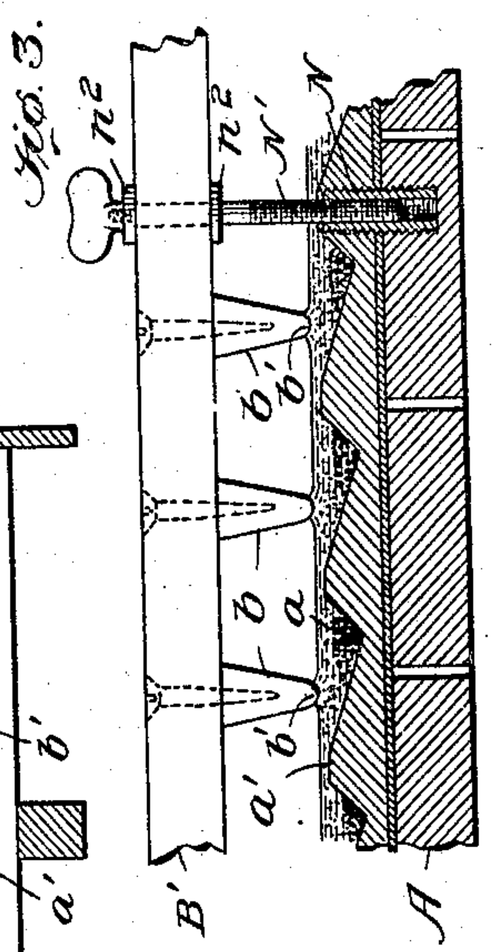

Fig. 3.

Fig. 7.

Fig. 6.

Fig. 5.

Fig. 4.

Witnesses

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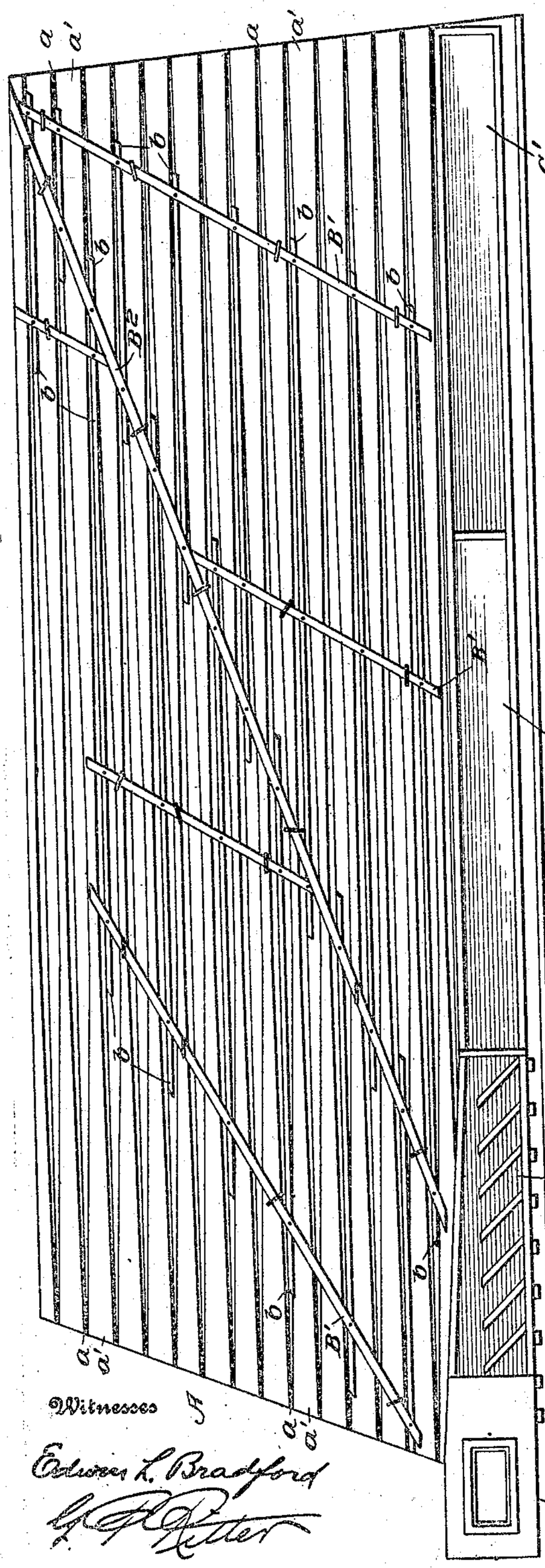

Fig. 8.

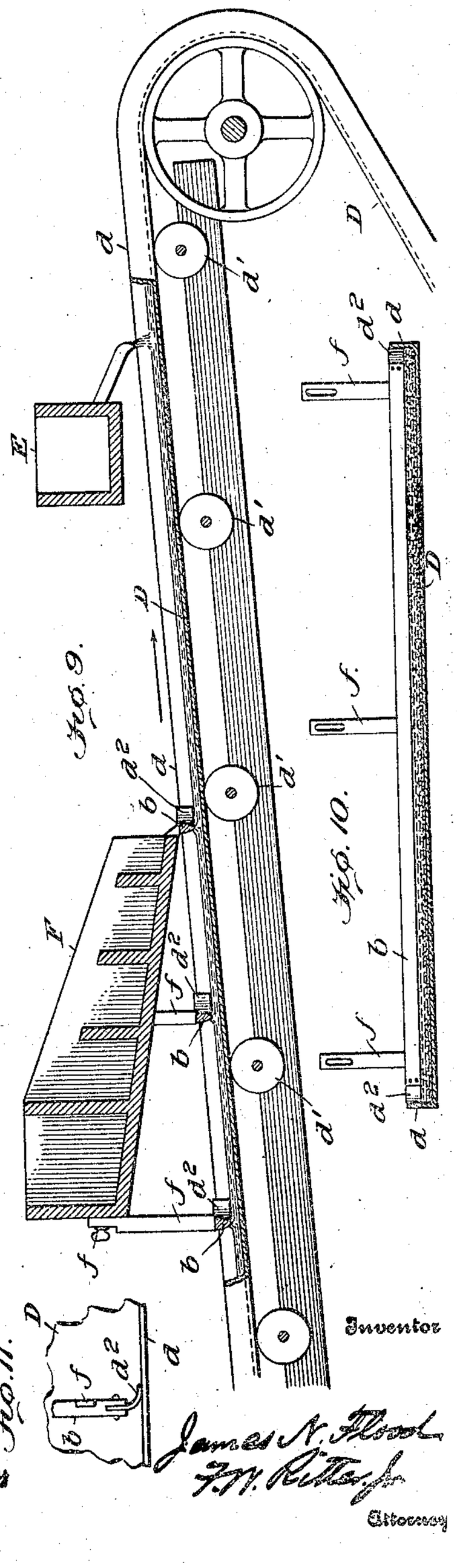

Fig. 9.

Fig. 10.

Fig. 11.

Witnesses

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3 SHEETS—SHEET 3.

Fig. 12.

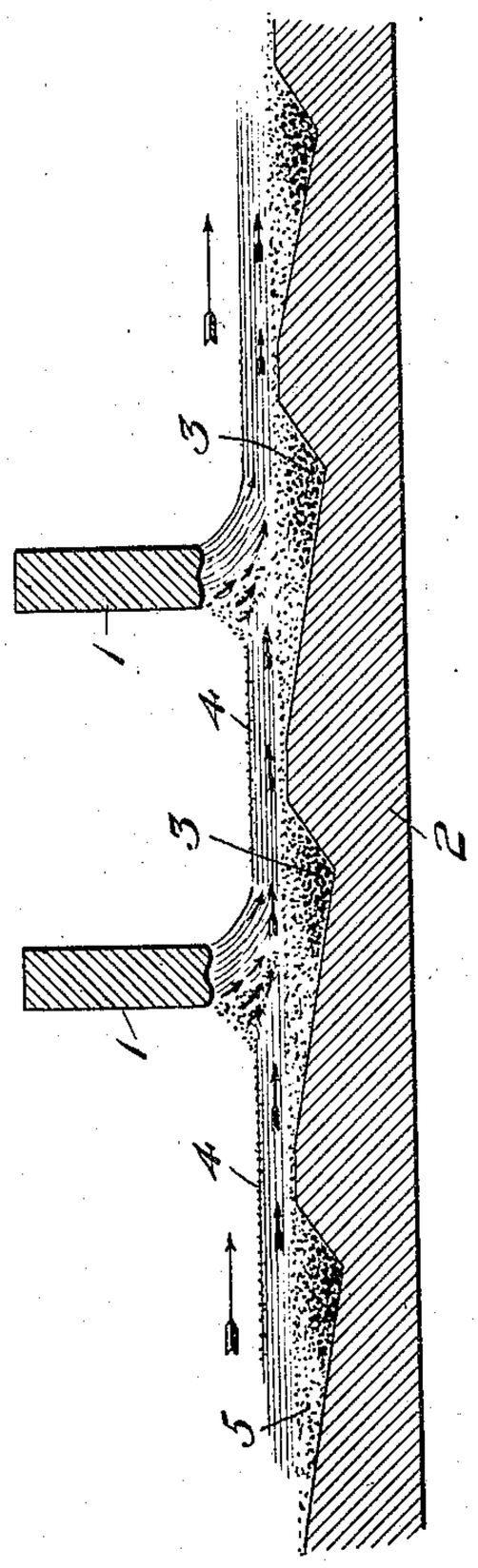
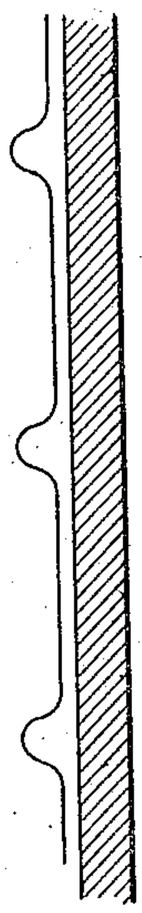


Fig. 13.



Witnesses

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UNITED STATES PATENT OFFICE.

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METHOD AND APPARATUS FOR SAVING SLIMES IN ORE CONCENTRATION.

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Application filed November 23, 1908. Serial No. 463,981.

To all whom it may concern:

Be it known that I, JAMES N. FLOOD, a citizen of the United States, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Methods and Apparatus for Saving Slimes in Ore Concentration; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to a method and apparatus for saving slimes and float metal in concentrating processes wherein a flow of dressing water is employed, as for instance in operating what are known as the Rittinger type of tables and the Vanner or belt types of concentrators. In each of said types of concentrators the separation of the values and gangue is effected by gravity in the presence of a flow of current of dressing water which carries off the gangue or lighter constituents of the pulp while the values are precipitated upon the table or belt and delivered therefrom by the movement of said table or belt.

The finely comminuted particles of metallics present in all crushed ore are held either in suspension near the surface of the water or float upon the surface, the surface tension and superficial viscosity of the water operating to support the very fine metallic particles. A large percentage of values is consequently inevitably lost with, or carried off in the tailings by the dressing water. In order to save such slimes or float mineral, I establish upon the surface of the dressing water employed a series of waves or upraised lines of water which intersect the direction of flow of the dressing water on the table, thus promoting precipitation of the floating metallic particles. These waves or upraised lines of water may be conveniently established by means of capillary attraction, the devices chosen for that purpose being so arranged that their lower edges are located above the normal level of dressing water.

As a special apparatus suitable for use in carrying out the main feature of my invention, I preferably employ a bar or series of bars of tapering cross section having the apex or apices thereof disposed above the surface of the dressing water, and in case of a channeled concentrator table, the bars are preferably located in alinement with the channels thereof; and said features constitute secondary or subordinate features of my invention.

There are other, minor, features of invention, involved in the elemental constructions and particular arrangements of the several parts of the apparatus, all as will hereinafter more fully appear.

In the drawings referred to herein and forming part of this specification, Figure 1 is a plan view of what is known as the Card construction of a Rittinger type of concentrator, the same having applied thereto apparatus adapted to the performance of my method of saving slimes; Fig. 2 is an end elevation of the apparatus, showing a transverse section of the table where the channels are widest; Fig. 3 is an enlarged detail sectional view of a portion of the apparatus and table shown in Figs. 1 and 2; Figs. 4, 5, 6 and 7 are detail views of modifications of the floats or bars which I prefer to employ as apparatus in practicing my method of concentration; Fig. 8 is a plan view of a table and the slime saving apparatus, showing an arrangement wherein the float bars are applied the whole length of a table having a diagonal line of flexure; Fig. 9 is a view of the front end of a Frue Vanner type of concentrator, showing, partly in side elevation and partly in vertical section, the application of the floats or bars thereto; Fig. 10 is a transverse sectional view of the Vanner belt showing the relation of the float thereto and to the dressing water flowing thereover; Fig. 11 is an enlarged detail plan view of a portion of the Vanner belt and one end of a float; Fig. 12 is a diagrammatic view similar to Fig. 3, illustrating the apparent effect produced upon the fine metallic particles; and Fig. 13 is a diagrammatic view illustrating a series of waves upon a plane concentrating surface.

Like symbols refer to like parts wherever they occur.

I will now proceed to describe my invention more fully, so that others skilled in the art to which it appertains may apply the same.

In the drawings, A indicates a concentrator table which may have a plain surface as in

the case of the old Rittinger style, or may, as in the present instance, have concentrate channels *a*, either formed in the bed or created by riffles corresponding to the lands *a'* between the channels or grooves *a*, *a*. For purposes of illustration the table selected is one in which the cross section of the channels *a*, *a* is formed by a long incline on the upper or feed side, and a short, abrupt incline on the lower or tailings side of the table, the two inclines meeting in an obtuse angle; but the character of the channel is not a material matter or one of the limitations of this invention. The diagonally disposed dotted line *x*—*x* appearing in Fig. 1 is employed to indicate a line of flexure in the table; but said line of flexure is no part of the present invention, nor is it material thereto, or to this description, except in so far as it assists, when taken in connection with Fig. 8 of the drawings, in showing how the slime saving apparatus may be readily applied to a table having such a line of flexure.

B indicates the feed box, and C, C' the dressing water boxes located on the upper or feed side of the table in the usual manner. The table will have the usual lateral inclination to induce the transverse flow of the dressing water and the discharge of the gangue, and will have a longitudinally reciprocating movement imparted to it by suitable mechanism (not shown) to discharge the concentrates, as is common to concentrators of this class.

b, *b* indicate a series of bars which are supported or suspended above the table with their lower edges above the normal level of the dressing water surface, in order to produce by capillary attraction the raised water lines, ridges or waves. While the under side of said bars may be brought approximately into the plane of or in contact with the normal surface of the dressing water, in no instance should they be allowed to dip beneath the water level, as the effect would be to set up deleterious underflowing water currents. By such an arrangement of the bars *l* the dressing water adjacent to the lower edges the eof is raised above its natural level to form a series of what may be termed capillary waves, as indicated diagrammatically in Fig. 13. For the purposes of this specification and as indicative that these bars are never submerged, I shall hereinafter term these elements *b* "floats". These floats *b*, *b* are preferably of tapering cross section so as to have a limited line or rounded edge *b'* presented toward the surface of the dressing water, and said edges may be single or multiple for each float *b*, as indicated in Figs. 4, 5, 6 and 7 of the drawings. As will be readily apparent, it is desirable that the floats should be vertically adjustable.

B', B' indicate coupling bars or cleats to the under surfaces of which the floats *b*, *b* are secured at intervals, preferably at intervals corresponding to the distance between the channels of a channeled or riffled table. As will be noted, said floats are arranged longitudinally of the table and consequently transversely of or across the flow of the dressing-water. Where a channeled or riffled table is used, as shown in the drawings, the floats are preferably located in line with and over the channels *a*, *a*. Any suitable means for supporting and adjusting the floats may be provided, as for instance those shown in the drawings, which consist of an internally and externally threaded sleeve or nut N embedded in the table and a threaded bolt N' which is plain where it passes through the cleat or coupling bar B' and is provided with collars n^2 for securing the coupling bar thereto so that the latter will be movable vertically with said bolt. The number of said adjusting devices N, N', and their location will depend on the number and arrangement of the floats *b* and coupling bars B' that the constructor desires to employ.

In Fig. 1 of the drawings the floats *b*, *b* are shown as confined to the dressing zone of the table, but they may be extended to the stratifying zone of the table, as indicated in Fig. 8 of the drawings, by simply arranging one of the coupling bars B^2 on the diagonal line of flexure (indicated by the dotted line, Fig. 1) and lapping the ends of the floats *b*, *b* thereon. In such a case, however, it is preferred to omit each alternate float, so that they will occupy a staggered relation on opposite sides of the line of flexure, as shown in Fig. 8.

In the case of the Vanner type of concentrator illustrated in Figs. 9 to 11 of the drawings, the form of the floats *b* and their relation to the surface of the dressing water are the same as in the case of the table heretofore described, that is to say, the lower edges of the floats are arranged to produce capillary waves transversely of the dressing water flow. In these figures of the drawings D indicates the belt of the concentrator which is provided with the usual upturned flanges *d*, and is supported in an inclined position, by the rollers *d'*, *d'* in the customary manner. E indicates the dressing water distributer and F the pulp distributer. The arrow shown in Fig. 9 indicates the direction of travel of the belt, which is contrary to the flow of the dressing water, so that while the gangue is carried backwardly and downwardly by the dressing water, the concentrates are carried forwardly and upwardly by the belt and are discharged into a suitable receptacle.

The floats *b*, *b* shown in Figs. 9, 10 and 11 are suspended by means of suspension bars or straps *f*, *f* that are adjustably secured to

the pulp distributer F by means of set screws f' which pass through elongated slots in the suspension bars. In order to prevent any slimes from passing between the ends of the floats and the upturned flanges d, d of the belt, the ends of the floats are provided with pieces d^2 of any suitable flexible material, preferably rubber, which sweep against or bear upon the upturned flanges d of the belt D. The pulp feeder F forms a ready and advantageou- means of suspending the floats; but such location or attachment of the floats is not essential or even material, as independent means of support for the floats may be provided and located over the belt at any point or points back of the pulp feeder.

The construction and arrangement of the apparatus being substantially such as hereinbefore pointed out its operation will be as follows: The pulp from the feeder B is distributed along the rearward upper side of the table or deck A and the dressing water is supplied to the table from the dressing water boxes C, C' in the usual manner. If the table is one capable of flexure on the diagonal line, the zone at the rear end and tailings side is slightly elevated to retard the transverse flow of the dressing water and facilitate the longitudinal forward travel of the concentrates. The usual longitudinal motion is imparted to the table. As soon as the level of the dressing water is established, the capillary floats b, b are adjusted so that their lower edges cause the formation of waves or ridges above said level, whereupon the slimes and float metals, instead of passing off with the tailings or gangue, will be affected by said waves and will be guided to and with the concentrates to the concentrate discharge end of the table, their travel being influenced by the endwise motion of the table, instead of by the flow of the dressing water as heretofore. The adjustment and operation of the floats are substantially the same in the Vanner type of concentrator as in the table. Where float mineral exists in excess, as in the case of sylvanite, petzite, chalcocite, tetrahedrite, stephanite and the like, only a portion of the arrested float mineral may be thrown down upon the belt, the remainder being held by the capillary floats until it extends to and passes over the upper roller with the other concentrates. The apparent effect of the capillary waves, as I have observed their action in this mode of concentrating upon a concentrator table, will be understood from an examination of Fig. 12 of the drawings, wherein 1 is a capillary float, 2 the concentrator deck, 3 a stratum of the coarser metallics, 4 float mineral, and 5 gangue. The feathered arrows show the direction of flow of the dressing water transversely of the table, and the featherless arrows indicate currents within the capillary wave. The capillary waves not only form upraised lines or ridges of water the crests of which contact the lower edges of the floats, but establish and maintain, both on the surface and internally, currents which capsize the floating particles and, wetting all their surfaces, carry them down to the bottom of the stream, from whence such wave induced currents are not strong enough to again raise the fine metallics, although they do raise the fine gangue matter and hold it in suspension so that it may pass off as waste.

By the practice of my invention, it will be noted, the percentage of slimed metallics in the tailings is at once largely reduced, as is also the amount of slimed silica in the concentrates, while the volume of the concentrates is materially increased.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. The method of saving slimes in concentrating processes wherein dressing water is employed to separate comminuted metallic particles from the accompanying gangue, which consists in effecting a flow of an aqueous mixture of the particles to be separated and establishing an upraised wave on the surface of said mixture without obstructing the flow of the mixture below the normal level thereof.

2. The method of saving slimes in concentrating processes wherein dressing water is employed to separate comminuted metallic particles from the accompanying gangue, which consists in effecting a flow of an aqueous mixture of the particles to be separated and raising the surface of said mixture at one or more places by capillary attraction without obstructing the flow of said mixture below the normal level thereof.

3. The method of saving slimes in concentrating processes wherein dressing water is employed to separate comminuted metallic particles from the accompanying gangue, which consists in effecting a flow of an aqueous mixture of the particles to be separated and impeding the flow of said mixture by the interposition of an obstruction just above the normal level of said mixture.

4. The combination with a concentrator and a dressing water supply therefor, of a float extending in a direction intersecting the direction of the dressing water flow, said float having at its lower surface capillary contact with the normal surface of the dressing water.

5. The combination with a concentrator and a dressing water supply therefor, of a bar float arranged transversely of the dressing water flow with its lower edge above the normal surface level of the dressing water and in such proximity to said surface as to establish capillary contact therewith.

6. The combination with a concentrator

deck having longitudinally disposed channels, and a pulp feeder and dressing water supply, of a plurality of longitudinally disposed float bars arranged in line with and over the channels and having at their lower surfaces capillary contact with the normal dressing water surface.

In testimony whereof I affix my signature, in presence of two subscribing witnesses.

JAMES N. FLOOD.

Witnesses:
FRANK S. CARD,
WILLIAM S. CARD.